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Scott M. Ronspies

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THE RELATIONSHIPS AMONG BODY MASS INDEX, DAILY STEP COUNT, AND  
TELEVISION VIEWING TIME IN CHILDREN AGES 10 TO 13

A Thesis

Presented to the

School of Health, Physical Education, and Recreation

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

University of Nebraska at Omaha

by

Scott M. Ronspies

May 2006

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## THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College,  
University of Nebraska, in partial fulfillment of the  
requirements for the degree Master of Science,  
University of Nebraska at Omaha

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Date 4/7/2006

# THE RELATIONSHIPS AMONG BODY MASS INDEX, DAILY STEP COUNT, AND TELEVISION VIEWING TIME IN CHILDREN AGES 10 TO 13

Scott Ronspies, MS

University of Nebraska, 2006

Advisor: Dr. Michael Messerole

The purpose of this study was to examine the relationships between body mass index, daily step count, and television viewing time in children ages 10 to 13. The study consisted of 66 female and 87 male participants with mean ages of 11.3 and 11.2, respectively. Mean scores for body mass index (BMI) were 20.2 for females and 20.4 for males. Mean television viewing time for both genders was 2.5 hours/day. Males recorded a higher mean step count total than females with scores of 12,283.2 and 10,316.7, respectively. Participants in the study wore the Yamax Digi-Walker SW-200 pedometer for recording total steps taken daily. Pearson Correlation for average step count (ASC) and BMI was  $-.191$ , which was significant at the 0.05 level of significance (2-tailed). ASC and TV viewing time showed a significant correlation of  $-.244$  at the 0.01 level of significance (2-tailed). BMI and TV viewing time showed a significant correlation of  $.484$  at the 0.01 level (2-tailed). The results showed low to fair positive and negative correlations for the three variables. In conclusion, the SW-200 is a valid and reliable pedometer to measure step counts in a youth population. The three variables did not show strong, positive relationships when compared to each another.

### **Acknowledgements**

This project required the work, time and patience of many exceptional people. Therefore, I wish to thank the following:

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## **Chapter One**

### **Introduction**

#### *Introduction*

The prevalence of obesity among children and adolescents is increasing at an alarming rate. According to the National Health & Nutrition Examination Survey (1999-2002), it is estimated that about 16% of children (6-11 years) and adolescents (12-19 years) are overweight ([www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm](http://www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm)). The accelerating rate of youth obesity in the United States indicates that this generation of children and adolescents will grow into the most overweight generation of adults in United States history (Guo, 1994). In a recent national study, among children 4 to 12 years old, 21.8% of Hispanics, 21.5% of African Americans, and 12.3% of non-Hispanic whites were overweight (Strauss & Pollack, 2001). Obesity during childhood and adolescence is reported to be a critical determinant of whether a subject will become obese as an adult. It has been found that 30% of girls and 10% of boys who were obese as youth became obese adults (Goran, 2001). It is also important to note that more than 60% of overweight children have at least one additional risk factor for cardiovascular disease, such as elevated blood pressure, hyperlipidemia, or hyperinsulinemia (Freedman, Dietz, Scrivinasan, & Berenson, 1999).

There is growing agreement among experts that environment plays a crucial role in the youth obesity epidemic (Hill, Wyatt, Reed, & Peters, 2003). The lifestyles and diets of American children are changing in response to our technological culture and the

availability of a wide range of foods. Access to computers, video games, and other media sources may also be contributors to the growing problem of youth obesity.

Obesity in the pediatric age group has been defined as an increase of total body fat in relation to observed norms in the population by age, sex and height, regardless of weight. That is, a person of normal weight carrying a higher than normal proportion of body fat might be considered as “obese” (Reilly, 1998). Obesity results from an energy imbalance created by factors that increase energy intake and reduce energy expenditure. Television (TV) viewing may promote obesity both by displacing participation in physical activity (PA) that would expend more energy, and by increasing dietary intake, either during viewing or as a result of food commercials. Other than sleeping, time spent watching TV represents the single greatest source of physical inactivity among American children (Dietz & Strasburger, 1991). Children vary a great deal in the amount of television they view. Some youth may watch 3-4 hours of television a day. At the highest end of the spectrum are youth that are addicted to television and show several symptoms of withdrawal when they are not able to watch TV (Kubey & Csikszentmihalyi, 2002). Watching television also exposes children and adolescents to advertisements of high-caloric “junk” food, and exposure to 30-second commercials has been shown to increase the likelihood that youth would later select an advertised food when given the choice (Borzekowski & Robinson, 2001).

Obesity in children is a complex and multifaceted disease for professionals to treat. The implication of large amounts of television viewing by children is not

completely understood. It appears that the more a child watches TV, the less likely they will engage in regular physical activity that will benefit their overall health.

### *Statement of Purpose*

The primary purpose of this study was to examine the relationships between body mass index, step counts, and television viewing time in children ages 10 to 13. The secondary purpose of the study was to examine the relationships between BMI and daily step count, BMI and TV viewing time, and step count and TV viewing time.

### *Research Questions*

- 1.) What is the difference between male versus female participants in regard to mean step counts?
- 2.) What is the correlation between average step counts and BMI for all the participants?
- 3.) What is the correlation between average step counts and average television viewing time for all participants?

### *Hypotheses*

Three different hypotheses were examined by this research study. They are as follows:

- 1.) It is hypothesized that males will have a higher mean step count than females.
- 2.) It is hypothesized that there will be a low, negative correlation between average step counts and BMI for all participants in the study.
- 3.) It is hypothesized that there will be a low, negative correlation between average step count and average television viewing time for all participants in the study.

### *Significance of This Study*

The proposed study may allow professionals who work with children/adolescents to assess their activity levels through the use of pedometers, and offer them information on methods to stay physically active and maintain a healthy lifestyle and body weight. With schools being pressured by budget cuts and lack of funds, the pedometer may provide a reliable, low cost method to determine activity levels, and provide motivation for this population of subjects to stay physically active.

### *Limitations of the Study*

The following limitations restrict the generalizability of the results of this study:

- 1.) BMI is only a predictor of one's body fatness.
- 2.) Participants used self reporting on the Self-Administered Physical Activity Checklist to report the amount of television they viewed (SAPAC).
- 3.) Pedometer error may have occurred if participants did not follow study protocol for using the pedometers; such as proper placement of the pedometer while wearing it.
- 4.) The study was completed at three catholic schools in a Midwestern city over the course of two months. Global generalizability to other schools and settings will be restricted.

### *Delimitations of This Study*

- 1.) The study was conducted at three catholic schools in a Midwestern city.
- 2.) The selection of the participants was limited to 5<sup>th</sup>-7<sup>th</sup> grade.
- 3.) Data were collected on subjects during the months of September/October.
- 4.) Some of the participants were former students of the primary researcher.

- 5.) Data were collected on 87 male and 66 female subjects from 5<sup>th</sup> through 7<sup>th</sup> grade.
- 6.) The Self-Administered Physical Activity Checklist (SAPAC) data were confined to self-reporting.
- 7.) Data were collected on participants during four school days.

### *Basic Assumptions*

- 1.) It is assumed that children's responses reflected their true television viewing times.
- 2.) It is assumed that children's responses reflected their true activity patterns.

### *Definition of Terms*

The following is a list of terms and definitions that are used throughout the study.

Each is provided to clarify the constructs which may influence this study:

- 1.) At risk of overweight for children/adolescents can be defined as subjects having a BMI-for-age 85<sup>th</sup> percentile to < 95<sup>th</sup> percentile according to the 2000 CDC Growth Charts for children and teens 2-20 years of age ([www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm](http://www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm)).
- 2.) Body Mass Index (BMI) can be defined as a common measure expressing the relationship of weight-to-height. It is a mathematical formula in which a subject's body weight in kilograms is divided by the square of their height in meters (wt/(ht)<sup>2</sup> if one is using the metric formula. For this study, the English formula will be used:  

$$(\text{wt. (lbs.)} / \text{ht. (inches)}^2) \times 703 = \text{BMI}$$
([www.cdc.gov/nccdphp/dnpa/bmi/00binaries/bmi-tables.pdf](http://www.cdc.gov/nccdphp/dnpa/bmi/00binaries/bmi-tables.pdf)).

- 3.) Overweight/obese for children/adolescents can be defined as subjects having a BMI-for-age  $\geq 95^{\text{th}}$  percentile according to the 2000 CDC Growth Charts for children and teens 2-20 years of age ([www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm](http://www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm)).
- 4.) Pedometer: a small instrument, worn on the hip that records the number of steps taken for weight-bearing activities (Brittenham, 2002).
- 5.) Physical activity (PA) can be defined as any bodily movement produced by skeletal muscles which results in energy expenditure beyond basal energy expenditure (Morrow, Jackson, Disch, & Mood, 2000).
- 6.) Step count refers to the total number of steps taken either daily or as a mean total.
- 7.) Underweight for children/adolescents can be defined as subjects having a BMI-for-age  $\leq 5^{\text{th}}$  percentile according to the 2000 CDC Growth Charts for children and teens 2-20 years of age ([www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm](http://www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm)).

## **Chapter Two**

### **Review of Literature**

A review of obesity, BMI, physical activity, step count, measuring step count with pedometers, and television viewing is presented in Chapter Two. Each section is detailed with current research on each topic in regards to its relationship to youth obesity.

#### *Obesity Overview*

The drastic rise in the prevalence of obesity in the United States has become a major health concern. Childhood obesity is linked to obesity in adulthood and furthermore it is associated with increased mortality, heart disease, hypertension, and diabetes (Teixeira, Sardinha, Going, & Lohman, 2001). The increasing number of obese children and adolescents demands an investment in the primary and secondary assessment and prevention of overweight and obesity with this population of subjects (Dietz, 2001). A decrease in energy expenditure is seen to be one of the major causes of the recent increase in obesity (Dionne, Almeras, Bouchard, & Tremblay, 2000). Patterns of physical activity (PA) as well as a sedentary living style appear to play an important role in long-term weight regulation (Bouchard, 2000). It has been pointed out that the increased prevalence of obesity may be associated with the reduction of physical activity, and efforts are needed to identify those factors related to weight gain with this population in order to effectively implement public health interventions (Grundy, 1998). Targeting children's patterns of physical activity is especially important given the argument that increasing physical activity in childhood might be essential for a lifetime of regular physical activity (Sallis & Owen, 1999). Physical activity seems to be an ideal focus



because it has many other benefits, such as body weight regulation, improving body composition, and increasing one's psychological and social well being (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993). If the patterns of physical activity that are established in childhood do carry over into adulthood, then it would appear to be extremely important to know as much about these patterns as possible, given the health implications associated with physical inactivity in adults. Thus, the importance of achieving a reliable and accurate estimate of body fatness, along with an accurate measure of physical activity, is essential for the prevention and treatment of obesity in children and adolescents. Knowing what factors may cause this increase in obesity may help decrease the alarming number of youth who are obese in the United States.

#### *Body Mass Index (BMI)*

Body Mass Index has been used for years to assess subject's body fatness levels. BMI is not used to diagnose, but rather to assess the relative risk for one being overweight or obese. This method is used by hospitals, health departments, and physicians across the world. The BMI is an index of a person's weight in relations to height, determined by dividing the weight (kilograms) by the height in meters squared. BMI is the most commonly used index to determine obesity, and is considered to be a reasonable measure in which to assess fatness in children and adolescents (Dietz & Bellizzi, 1999). Roche, Siervogel, Cameron, and Webb (1988) examined BMI and found high correlation with underwater weighing tests as the reference test for children 6-12 years old (boys,  $r = 0.90$ ; girls,  $r = 0.84$ ).

In a study by Wildhalm, Schonegger, Huemer, and Auterith (2001), 204 obese subjects (105 boys, 99 girls) were assessed for body fat levels comparing BMI data to total body electrical conductivity (TOBEC). Subjects ranged in ages of 6-17 years of age. The results showed a positive correlation between BMI and percent body fat scores (overall:  $r = 0.65$ ;  $P = 0.0001$ ; boys  $r = 0.63$  and girls:  $r = 0.68$ ). Through a multiple regression analysis, 57% of the variance of percent body fat could be explained by the independent variables. In boys and girls younger than 10 years old, 73% (boys) and 63% (girls) of the variance of percent body fat was explained by BMI.

Sarria et al. (2001) showed strong support for using BMI to assess body fatness in youth. This was one of a few studies that examined the sensitivity and specificity of the BMI against total body fat percentage from underwater weighing in children and adolescents. A total of 175 males, ages 7.0 - 16.9 years of age, participated in the study. Total body fat percentage was measured using underwater weighing as the reference method. The objective of the study was to evaluate the performance of BMI, triceps skinfold thickness, and waist circumference for excess total body fat percentages. Receiver operating characteristic curves (ROC) were constructed to assess the value of the three measures. Sensitivity and specificity were calculated at several percentile cut-offs for BMI, triceps skinfold, and waist circumference. The areas under the curves were 0.86 for BMI, 0.90 for triceps skinfold, and 0.88 for waist circumference. The ROC curve is a plot of true-positive rates against false-positive rates, obtained over a range of cut-off points from the screening measure. The point on the ROC curve closest to 1 corresponded to the 70<sup>th</sup> percentile for BMI, to the 75<sup>th</sup> percentile for triceps skinfold, and

to the 70<sup>th</sup> percentile for waist circumference. The results showed that all three measures predicted total fat content accurately in male children and adolescents.

Although BMI is a common method of assessing body fatness, it does have its limitations. BMI must always be reported according to the age of the population being studied (Dalton & Watts, 2002). For example, average BMI is about 16 for children ages 6-7 years of age; at 17 years of age, the average BMI is close to 22. The 2000 growth charts published by the Centers for Disease Control and Prevention (CDC, 2004) are based on data from several ethnic groups and are age appropriate to use with a child or adolescent population of subjects (Kuczmarski et al., 2000).

### *Physical Activity*

Regular physical activity is related to a decrease in chronic diseases and associated risk factors (Sirard & Pate, 2001). Physical activity is critical to any consideration of youth obesity. If one is to understand the increasing rate of obesity in young people, one must also understand the importance of exercise patterns. *Healthy People 2010* guidelines show that regular physical activity can also help control body fat, enhance joint mobility, increase bone density, and improve muscle strength and endurance, along with improving one's overall feelings of well-being (U.S. Department of Health and Human Services, 2000). Although the research on the importance of physical activity and its benefits is plentiful, it is estimated that about 50% of U.S. children do not participate in vigorous activity on a regular basis (Davison & Birch, 2001), and as children get older, their participation in physical activity tends to decline (Dovey, Reeder, & Chalmers, 1998). Health statistics released by the Centers for Disease

Control and Prevention (CDC, 2004) indicate that 69% of children ages 12-13 years reported that they regularly participate in vigorous physical activity compared to 38% of people ages 18-21 years of age. If we, as a society, are to combat this obesity epidemic among our youth, physical activity has to be implemented into children and adolescents lives on a regular basis.

Trost, Kerr, Ward, and Pate (2001) compared physical activity levels and showed that there was a significant difference in the amount of moderate physical activity (MPA) (3 – 5.9 METs), vigorous physical activity (VPA) ( $\geq 6$  METs), and the number of 5, 10, and 20 minute bouts of moderate-vigorous bouts of activity between two groups of sixth graders; in which one group was obese and the other was not. One-hundred and thirty-three non-obese and 54 obese sixth grader children (mean age of  $11.4 \pm 0.6$ ) were used in the study. Obese children exhibited significantly lower participation in moderate physical activity (62.6 vs. 78.2 min/day) ( $p = .05$ ); vigorous physical activity (7.1 vs. 13.5 min/day) ( $p = .0001$ ); and significantly fewer 5-min (15.9 vs. 23.4) ( $p = .001$ ), 10-min (8.5 vs. 12.6) ( $p = .002$ ), and 20-min bouts (3.9 vs. 5.8) ( $p = .009$ ) of moderate-vigorous physical activity. Subjects were classified as obese if their BMI was greater than or equal to the 95<sup>th</sup> percentile for their respective age, race, and sex from the National Health and Nutrition Examination Survey I. The results indicated that physical inactivity is an important contributing factor in the maintenance of childhood obesity.

Fogelholm, Nuutinen, Pasanen, Myohanen, and Saatela (1999) studied the differences between normal-weight and obese children, as well as parent-child associations of obesity and physical activity. The subjects included 129 obese children

(67 girls and 62 boys), 142 normal-weight controls (81 boys and 61 girls), and mothers (n = 245) and fathers (n = 122) of the children. Physical activity was assessed by a 3-day physical activity record (child and parent), by a questionnaire (child), and by one question of habitual physical activity (parent). Obesity was assessed from relative weight (child) and BMI (parents). Parent inactivity was a strong and positive predictor of child inactivity ( $\beta$ -coefficients 0.25 and 0.16,  $P < 0.001$ , for mothers and fathers inactivity, respectively). Scores of parent activity were somewhat weaker predictors of child vigorous activity hours and total physical activity level ( $\beta$ -coefficients 0.13 – 0.25,  $P = 0.003 – 0.08$ ). Child obesity was negatively associated with child habitual physical activity (odds ratio 0.88,  $P < 0.001$ ). Parent obesity ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ) was another strong predictor of child obesity (odds ratio 2.38 – 3.50,  $P < 0.002$ ). It was concluded that parents play a vital role in childhood obesity. An important finding was that the parent-child relationship of inactivity appeared to be stronger than that of vigorous activity. It makes sense to say that if parents want to reduce their children's inactivity, they may have to pay more attention to their own lifestyle.

Other researchers have tracked physical activity and aerobic power from childhood to adolescence. McMurray, Harrell, Bangdiwala, and Hu (2003) tracked physical activity and aerobic levels in African American (AA) and Caucasian (CA) youth as they aged from 8 to 16 years. Subjects included 529 girls and 535 boys for whom data was obtained at least three times over 7 years, and a subset of 387 girls and 404 boys who participated in all years. Physical activity was obtained from a survey, and aerobic power was performed on a cycle ergometer. Spearman correlation for  $\text{VO}_2$  max for years 1-7

for AA boys and girls were similar ( $p \sim 0.53$ ). Year 1-7 correlations for VO2 max for the CA boys and girls were similar ( $p \sim 0.50 - 0.53$ ). The years 2-7 correlations for physical activity were similar for the AA and CA girls but higher for the AA than the CA boys. The conclusion was that physical activity and aerobic power levels declined from childhood to adolescence. If change is going to happen, intervention must take place early in the lives of youth.

The variables which affect the physical activity patterns of children are important to know and understand, but without valid and reliable measurement instruments to investigate the effects and relationships of these determinants, a solution will never be reached. Valid measures of estimating physical activity in children and adolescents are critical to understanding the relationship between physical activity and chronic diseases and associated risk factors. Accurate knowledge of physical activity levels allows researchers to develop intervention programs and to assess their effectiveness.

### *Step Counts*

A value of 10,000 steps has gained popularity with the media when examining the amount of steps a healthy adult should take each day. Although this number may seem to be universal, it does not target all groups. One concern is that 10,000 steps are too low for children and adolescents, which is a target population for the fight against obesity. The President's Council on Physical Fitness and Sports (2001) recognized that 10,000 steps a day was likely to be too low for young people. They recommend that 11,000 steps (girls) and 13,000 steps (boys) be taken at least 5 days a week for a standard health base.

Whether or not these values will prevent or decrease youth obesity is still unknown at this time.

Vincent, Pangrazi, Raustorp, Tomson, and Cuddihy (2003) examined correlation analysis on 6-12 year olds, and found little relationship between step counts and BMI. Of the 40 correlations calculated, only five showed a significant negative relationship between step counts and BMI, and those correlations were relatively low. This means that little relationship was found between step counts and BMI. Significant correlations at  $P < .01$  were found for American boys ages 11 ( $r = -0.389$ ) and 12 ( $r = -0.553$ ) and American girls age 9 ( $r = -0.364$ ). American girls age 8 ( $r = -0.276$ ) had significant correlations at  $P < .05$ . The relationships found were in the direction expected (negative), and the greatest correlation ( $r = -0.553$ ) for 12 year old American boys accounted for 28.4% of the variance. In this study, the data does show some relationship, but it is not consistent across all comparisons in the study.

Brittenham (2002) conducted a study on physical fitness and testing, along with data on step counts of first, second, third, fourth, and fifth grade students. A total of 298 students (158 girls & 140 boys) were included in the study. Mean and standard deviations for daily step counts were computed for each grade level. The daily average number of steps was computed by averaging the seven day step counts for each grade level. The daily average number of steps increased for females from first grade ( $M = 9,551$  steps) through fourth grade ( $M = 12,512$  steps). At fifth grade, the females' daily step average was 9,618 steps, a decrease of 2,894 steps compared to fourth grade females. The daily average number of steps increased for males from first grade ( $M = 10,798$

steps) through third grade ( $M = 14,092$  steps). The steps decreased at fourth grade ( $M = 12,796$  steps) and increased again at fifth grade ( $M = 13,268$  steps). It was concluded that males averaged more steps than females at each grade level.

Much of the research reported on youth physical activity levels is collected using self-reports or questionnaires. These methods offer a quick, low cost method of collecting data, especially when sample populations are large in number. The use of questionnaires and self-reports can be problematic because of the potential for inaccurate recall. Elementary school children have difficulty providing accurate self-reported information about their physical activity levels (Welk, Corbin, & Dale, 2000). In addition, these reports can be long and tedious for both the participants and the researchers. Researchers agree that there needs to be a more objective measure of physical activity, especially among children and adolescents (Tudor-Locke & Myers, 2001).

#### *Measuring Step Counts with Pedometers*

Physical activity and step count are multi-dimensional behaviors; therefore no single tool can capture all of the dimensions. It can be more difficult to measure a behavior than to measure an attribute. No single assessment tool of physical activity meets all the requirements of measuring such as: validity, reliability, practicality, and non-interfering. The method used must take into account the research problem, sample size, time, setting, and budget (Dishman, Washburn, & Schoeller, 2001).

The electronic pedometer currently used has a horizontal, spring-suspended lever arm which moves up and down with vertical accelerations of the hip. With each step, an



electrical circuit is closed and one step is recorded (Bassett et al., 1996). Kilanowski, Consalvi, and Epstein (1999) concluded that measurements taken with a pedometer are highly correlated with physical activity in children. The pedometer is an inexpensive, valid method of assessing physical activity levels in large populations, and a source of feedback for intervention studies. In addition, the Yamax brand has a cover which “blinds” subjects to the results. A limitation to the pedometer is that it does not record or store activity data by time (Kilanowski et al., 1999). The Yamax Digiwalker SW-200 model records only vertical accelerations, thus for activities involving arm movement (static work), the pedometer would not be accurate in predicting energy expended (Bassett et al., 2000). Eston, Rowlands, and Ingledew (1998) concluded that pedometer readings correlated highly with direct observations of physical activity in four to six year old children.

Bassett et al. (1996) concluded that the Yamax step counter registered the same number of steps independent of which side of the body the pedometer was worn. Kilanowski et al. (1999) found a high correlation ( $r = 0.95$ ) between pedometer readings and behavioral observation of physical activity with children ages nine to eleven. In addition, the unobtrusive size and cost make pedometers a useful objective measure of children’s physical activity. The mentioned study concluded that pedometers were appropriate in use to assess children’s physical activity levels (Kilanowski et al.).

It appears that the Yamax brand pedometer is one of the most accurate pedometers on the market. The low cost and ease of use makes this a great tool for doing research with various types of subject populations. The 3% margin of error standard

(Hatano, 1993) allows researchers to be confident that the data obtained from the pedometer is valid and reliable to assist subjects in knowing their physical activity levels.

### *Television Viewing & Obesity*

American children spend 24 hours each week in television viewing (National Institute of Diabetes and Digestive and Kidney Diseases, 2002). It has been calculated that the average high school graduate will likely spend 15,000 to 18,000 hours in front of the television but only 12,000 hours in the classroom (Bar-on, 2000). It is estimated that 32% of 2-7 year olds and 65% of 8-18 year olds have a television in their bedrooms (Roberts, Foehr, Rideout, & Brodie, 1999). Television viewing is an antecedent of sedentary lifestyles and obesity, suggesting that researching this behavior might be useful for assessing prevalence rates of sedentary behavior and risk for obesity in children (Crespo et al., 2001). There is speculation that television viewing is one of the most easily modifiable causes of obesity among children and adolescents. Two primary means by which television viewing contributes to obesity are a reduction in energy expenditure from displacement of physical activity and an increased dietary energy intake, either during viewing or afterwards. Because the current environment of television promotes less healthy foods, making wise food choices can be difficult for children (Robinson, 1999).

Data from the National Health and Nutrition Examination Survey II and III found that the prevalence of overweight increased by 2% for each hour of television viewed daily among adolescents 12-17 years of age (Crespo et al., 2001). Another aspect of television viewing that may increase the prevalence of obesity in the children/adolescent

population is the lower resting metabolic rate (RMR) many youth experience while viewing television programs when compared to other sedentary activities, such as reading. A lower RMR contributes to obesity by reducing the rate at which consumed energy is metabolized (Tanasescu, Ferris, Himmelgreen, Rodriquez, & Perez-Escamilla, 2000).

Klesges, Shelton, and Klesges (1993) studied the effects of television viewing on resting energy expenditure (metabolic rate) in obese and non obese children. The subjects included 15 obese and 16 non obese children ages 8-12 years. All subjects had two measures of resting energy expenditure obtained while at rest and one measurement of energy expenditure while watching TV. The results from the study indicated that metabolic rate during TV viewing was significantly lower (mean decrease of 211 kcal extrapolated to a day) than during rest. Obese children tended to have a larger decrease, although this difference was not statistically significant (262 kcal/day vs. 167 kcal/day, respectively). It was concluded that TV viewing has a fairly profound effect of lowering one's metabolic rate and may be a mechanism for the relationship between obesity and amount of TV viewing.

Proctor et al. (2003) examined the relationship between television watching and body fat change in children from preschool to early adolescence. In this study, 106 children were enrolled during their preschool years (mean age 4.0 years), and followed into early adolescence (mean age 11.1 years). Parents completed questionnaires on the child's television habits and overall video habits. BMI, triceps skinfolds, and sum of five skinfolds were recorded yearly at a clinic. The results showed that by age 11, children

who watched 3.0 hours or more of television per day had a mean sum of skinfolds of 106.2 mm, compared with a mean sum of skinfolds of 76.5 mm for those who watched less than 1.75 hours per day ( $P = 0.007$ ). Furthermore, the adverse effect of television viewing was worse for those children who were also sedentary or had higher-fat diets. It was concluded from this study that children who watched the most television during childhood had the greatest increase in body fat over time. Television habits should be monitored to help prevent obesity in children.

Wake, Hesketh, and Waters (2003) investigated the relationships between children's BMI and parents reports of children's television and video game/computer habits, while controlling for other potential risk factors for obesity. A total of 2,862 children (ages 5-13) in Victoria, Australia participated in the study. Parents reported the amount of time children watched television and used video games/computers, children's eating and activity habits, parental BMI, and socio-demographic details. The results showed that child mean BMI z-score was significantly related to television ( $F = 10.23$ ,  $P < 0.001$ ) but not video game/computer time ( $F = 2.23$ ,  $P = 0.09$ ), but accounted for only 1 and 0.2% of total BMI variance, respectively. When parental BMI, parental education, number of siblings, food intake, and activity levels were included, television ceased to be independently significantly related to child BMI. Using adjusted logistic regression, the odds of being overweight and obese generally increased with increasing television viewing. No relationship was found for video game/computer use. It was concluded from this study that a small proportion of variance in child BMI was related to television viewing, but not video game/computer time.

Buckenmeyer, Hokanson, Adams, Hamilton, and Jaconski (2004) examined physical activity patterns of children in a central New York community. The purpose of the study was to assess physical activity levels versus the amount of television watched by children in Cortland County, NY. Physical activity surveys were sent throughout the community. Of the 10,000 sent, 1,400 were used in the study. The 7 question survey contained items regarding physical activity of both adults and children. Children were grouped into three age brackets (1-6 years, 7-12 years, and 13-18 years). Children from the survey were mostly from low income families (58.5% were families making < \$20,000 per year). The results from the study showed no significant difference in the average amount of physical activity between the age groups of children. Children aged 1-6 years exhibited a 10% and 9% higher duration of physical activity (> 6 hrs/wk) compared to the 7-12 and 13-18 year olds, respectively. This correlated indirectly with the amount of television (> 6 hrs/day) watching of these same age groups. The 1-6 year olds watched 6% less than the 13-18 year olds. It was concluded that as age increases from 1-6 years to 13-18 years, there is an indirect trend toward a lesser amount of physical activity and greater amount of television watching in this sample of subjects.

## **Chapter Three**

### **Methods**

#### *Participants*

The participants of this study were selected according to availability and desire to participate. The subjects consisted of 87 male and 66 female students in 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> grades (5<sup>th</sup> = 60 participants, 6<sup>th</sup> = 42 participants, 7<sup>th</sup> = 51 participants). The original number of participants who volunteered to be involved in the study was 216. Participant data were excluded from the study if participants had incomplete data, days missed from school, or participants choosing not to participate or terminate participation at any time during the study. Mean age of the participants was 11.2 (SD = .9). Participants were from various ethnic groups (62% Caucasian, 30% Hispanic, 8% Other), and were enrolled in three catholic schools in the Omaha-Metropolitan area. The average percentage of participants on free and reduced lunch for the three schools was 62%. Participants were enrolled in catholic school with a predominately low-moderate social economic class. Approval from school principals and the University of Nebraska Institutional Review Board regarding research with human subjects was obtained. All participants returned both a parental and youth informed consent form signed by themselves and their parents.

#### *Instrumentation*

BMI was calculated for each participant. Height was measured with participants in socks and their school uniform using a standard wall stadiometer. Height was measured to the nearest 0.5 cm. Body mass for each participant was measured with

participants wearing only their school uniform and no shoes. A calibrated Health-O-Meter scale was used to measure body mass to the nearest 0.5 kg. Once these data were collected, the values were placed on the Center for Disease Control and Prevention (2004) BMI-for-age growth charts for calculating BMI values for selected heights and weights for subjects ages 2-20 years. This table provided each subject with a BMI that would be used in the study.

### *Step Count*

To obtain a daily step count for each participant, the Digiwalker SW-200 pedometer was used in the study. This brand of pedometer was used because it has been shown to have a lower error rate than other pedometer brands (Bassett et al., 1996). The Yamax brand step counter, Digiwalker SW-200 model, measures total number of steps taken. The Yamax brand has shown a high consistency between units (Bassett et al., 1996). It is speculated the Yamax is the most accurate pedometer on the market because of the strict Japanese Industrial Standards, only allowing for a 3% margin of error (3 steps out of 100) in counting steps (Hatano, 1993). Pedometer research has gained much popularity in recent years. With the ease of use, and valid and reliable measures, pedometers are being used to measure physical activity levels amongst various subject populations. The Yamax pedometer has gained much attention in the literature for its validity and reliability.

Vincent and Sidman (2003) tested the Yamax Digiwalker SW-200 model for measurement error. A walking test was conducted on 11 adults (8 women, 3 men, ages 27 to 54). Each subject wore four pedometers (two on the right side of navel and two on

the left of side of the navel). Each subject repeated this procedure six times until they had worn all 24 pedometers. Subjects walked in a gym while counting their own 100 steps. A researcher recorded counts after each 100 steps. A shake test was also conducted on each pedometer. Each pedometer was placed in a shake box and shook 100 times. One end of the box remained on the table while the other end was moved in a vertical direction 100 times. The mean deviation from the 100 steps for the walk test was  $2.26 \pm .80$  (M $\pm$ SD) and  $1.71 \pm .88$  on pretest and post-test, respectively. Mean deviation from the 100 shakes was  $0.39 \pm 0.29$  and  $0.60 \pm 0.62$  for the pretest and post-test, respectively. No pedometer exceeded 5% error on any of the tests. It was concluded that the Yamax Digiwalker SW-200 is a valid and reliable tool to measure physical activity on subjects.

### *Activity Levels*

Scruggs et al. (2003) conducted a study to determine pedometer steps per minute standard for quantifying the lesson time in Physical Education that first and second grade students spent in moderate to vigorous physical activity. The sample was divided into validation (n = 246) and cross-validation (n = 123) samples using the holdout technique. Data were collected from 45 Physical Education lessons in six schools. The three-step procedure of computing mastery/non-mastery outcome probabilities, phi coefficients, and error proportions was used to determine optimal steps per minute cut point for quantifying 33.33% of the lesson time spent in moderate to vigorous physical activity within a 30 minute lesson. The Yamax Digiwalker SW-701 pedometer was used to count steps taken, which is similar and of the same brand as the SW-200 model. The only



difference in the two pedometers is that the SW-701 also measures distance and calories. It was concluded that steps per minute were highly correlated with observation ( $r = 0.74 - 0.86$ ,  $P < 0.0001$ ). The data supported the use of the Yamax pedometer to obtain accurate steps per minute values as indicators of moderate to vigorous activity levels in Physical Education classes for children.

Wilde, Corbin, and Masurier (2004) investigated free-living step counts of students in grades 9-12. The purpose was to assess step counts in this population in regards to sex and age. Of the 369 subjects, there were 179 males and 190 females. There were 91 ninth graders, 88 tenth graders, 87 eleventh graders, and 103 twelfth graders. The ages ranged from ( $14.9 \pm 0.4$ ,  $15.9 \pm 0.4$ ,  $16.7 \pm 0.5$ , and  $17.6 \pm 0.5$  years for grades 9, 10, 11, 12, respectively). The Yamax Digiwalker SW-200 was used in the study because it has been shown to have a lower error rate than any other pedometer brand. Subjects wore the pedometer for 4 consecutive school days. The results indicated no difference among days of monitoring but did show a significant difference in mean steps per day between sexes, grades, and among activity levels. The Yamax pedometer was shown to be accurate in assessing the daily activity levels of students in grades 9-12.

Vincent and Pangrazi (2002) assessed current physical activity levels of children to establish initial standards for comparison in determining appropriate activity levels of children based on pedometer counts. Children, 6-12 years old ( $N = 711$ ), wore the Yamax Digiwalker SW-200 pedometer for 4 consecutive days. Mean step counts ranged from 10,479-11,274 and 12,300-13,989 for girls and boys, respectively. The conclusion from this study was that it appears that 11,000 steps for girls and 13,000 steps for boys

appears to be a reasonable activity standard for each group. The SW-200 pedometer was found to be a valid and reliable tool in assisting in formulating these benchmarks.

### *Pedometer Accuracy Test*

All pedometers were checked for calibration before participant use. If error exceeded  $\pm 5\%$ , the pedometer was not used in the study. To check for accuracy, the researcher performed a 20 step test on each pedometer. From a standstill position, 20 steps were taken to check the count on each pedometer. If the number after the 20 steps was within 1 step of the 20, it was considered accurate. If the count was less or more 1 step from 20 steps, the pedometer was moved either closer to the side of the body or closer to the navel and the test was performed again until the pedometer was positioned correctly on the body. This test was performed on each participant prior to actual data collection. Participants were instructed prior to the study to maintain their normal activity patterns during the study. Prior to the study, students were given the opportunity to examine the pedometers and use them during three physical education classes. Using the pedometers in Physical Education class was done to get them comfortable with the instrument and reduce subject curiosity about how the pedometer works. The practice time was incorporated to instruct each subject on where to properly place the pedometer on the waist in order to obtain the most accurate step count, and how to clip the pedometer onto the clothing securely. Participants were instructed to wear the pedometer throughout the day until they went to bed, at which time they removed the pedometer and placed it securely on a nightstand. Special attention was given to using the security strap on each pedometer. The strap has a clip that can be secured to the clothing to prevent the

pedometer from falling off or being jiggled. Instructions were given not to get the pedometers wet or to open the pedometer during any testing time. Participants were instructed to put the pedometer back on the next morning when they got dressed and to wear it to school.

### *Pedometer Data Collection*

The pedometers were fastened to the waistband of the participants' skirts, pants, or shorts. All pedometers were worn on the right side of the body, and positioned according to the subject's body size. The midpoint of the right knee was used as a reference mark for pedometer positioning. During the study, participants wore the pedometers for four consecutive days. Beginning on a Monday, each child put on a pedometer at 8:00 a.m., and wore it until they went to bed. When they got dressed the next morning, they put the pedometer back on and wore it to school. During the times between 8:00-8:15 a.m., the researcher recorded the total step counts, reset and resealed pedometers, and returned them to the subjects to be worn. A total step count at the end of each measurement period was recorded for statistical analysis, along with an average number of steps from the four testing days. This procedure was repeated for each participant for four consecutive school days (Monday morning through Friday morning). A four day monitoring frame was used in order to obtain reliable estimates of habitual physical activity behavior using sealed pedometers. Vincent and Pangrazi (2002) concluded that 3 to 4 days of pedometer monitoring are sufficient in order to determine habitual physical activity levels in children.

### *Television Viewing*

The SAPAC (Self-Administered Physical Activity Checklist) was used to assess the amount of television viewing time each subject viewed on a daily basis. This type of report is one of the most commonly used types of measure of children's physical activity due to its convenience of administration, low cost, and ability to collect a wide variety of physical activity variables over time. The form consisted of a list of 22 physical activities, space for listing up to two other activities, three walking and/or running activities and an additional section for reporting TV/video/DVD viewing and computer/video game playing. Time is only recorded if it was more than 5 minutes. The form was completed daily by participants and their parents, and returned on the Friday morning of monitoring. The data were collected from the four monitoring days, and the values were averaged to obtain a value for the amount of television watched daily.

Sallis et al. (1996) conducted a study to validate the SAPAC with fifth grade students. Subjects for the study were 55 boys and 70 girls from various ethnic groups and from four regions of the United States. When compared to the heart rate monitor, the SAPAC showed a correlation of 0.57 ( $P < 0.001$ ). From this study, the validity correlations were higher than those of other published physical activity self-reports with children of this age. It was also noted that the SAPAC is the most cost effective method to assess children's physical and sedentary activity levels. The advantages of even moderate correlations on self-report scales seem to outweigh the disadvantages of direct observation in studies which require large samples. Direct observations can be very labor intensive, and usually require highly trained researchers to conduct the observations.

Based on this information, the SAPAC may be considered the most valid self-administered self-report scale available.

### *Data Analysis*

Data was compiled onto Excel spreadsheets and imported into SPSS. The first research question was tested using a standard mean calculation to show the difference in step counts of male versus female subjects. Pearson correlations were used to test research questions two and three. Means were calculated for all subjects in terms of age, BMI scores, average step counts, and average television viewing. Stepwise regression was calculated for the following: Average step counts versus gender, age, BMI, and average television viewing. An alpha level of 0.05 was used for all statistical tests.

## **Chapter Four**

### **Results**

Descriptive statistics for both genders were calculated in regards to age, BMI, average step counts, and average television viewing. For female subjects ( $n = 66$ ) the mean age was 11.3 years with a standard deviation of ( $SD = .9$ ). BMI scores had a mean of 20.2 with ( $SD = 5.0$ ). Average step counts (ASC) had a mean of 10,316.7 steps with ( $SD = 3,753.9$ ). The mean for average TV viewing time was calculated at 2.5 hours with ( $SD = .5$ ). Male subjects ( $n = 87$ ) mean age was 11.2 years with ( $SD = .9$ ). BMI scores had a mean of 20.4 with ( $SD = 4.3$ ). Average step counts had a mean of 12,283.2 steps with ( $SD = 1,012.8$  steps). Average TV viewing time had a mean of 2.5 hours with ( $SD = .5$ ). These results are found in Table 1.

Table 1

#### Summary of Results

	<b>Age (yrs.)</b>	<b>BMI (in./lbs.)</b>	<b>ASC (steps)</b>	<b>ATV (hours)</b>
<b>Female (<math>n = 66</math>)</b>				
Mean	11.3	20.2	10,316.7	2.5
SD	.9	5.0	3,753.9	.5
<b>Males (<math>n = 87</math>)</b>				
Mean	11.2	20.4	12,283.2*	2.5
SD	.9	4.3	1,012.8	.5
<b>All Subjects (<math>N = 153</math>)</b>				
Mean	11.2	20.3	11,434.9	2.5
SD	.9	4.6	2,749.8	.5

\* $P < 0.05$ , Male step count significantly greater than female

The primary purpose of this study was to examine the relationships between body mass index, step count, and television viewing in children ages 10 to 13. Research Hypothesis #1 states: **It is hypothesized that males will have a higher mean step count than females.** The hypothesis was accepted in that males on average took more steps per day than females with a mean step count of 12,283.2 steps for males and 10,316.70 steps for females. The step count for males versus females was computed with a difference of 1,966.54 steps. This difference was significant at the  $P < 0.05$  level.

Research Hypothesis #2 states: **It is hypothesized that there will be a weak, negative correlation between average step counts and BMI for all subjects in the study.** This hypothesis was accepted. The Pearson correlation did show a low correlation of  $-.191$  which was significant at the 0.05 level (2-tailed). The data in this study showed that as subject's average step counts decreased, their BMI scores increased.

Research Hypothesis #3 states: **It is hypothesized that there will be a weak, negative correlation between average step counts and average television viewing for all subjects in the study.** This hypothesis was accepted. The Pearson correlation did show a low correlation of  $-.244$  which was significant at the 0.01 level (2-tailed). The data from this study showed that as subject's average step counts decreased, their average TV viewing increased.

Forward stepwise regression revealed that average step count was best predicted by gender and average TV viewing time (ATV). Gender was the best single predictor explaining 12.6% of the variance ( $P < .001$ ), with a standard error of estimate (SEE) of 2,578.8 steps. The SEE of 2,578.8 steps was the average value each subject varied from

the predicted score or predicted line of best fit. The R-value of .355 indicates that the results did not have a good fit around the predicted line from the regression equation. With gender and average TV viewing time as the predictors, 18.5% of the variance could be explained ( $P < .001$ ), with a standard error of estimate (SEE) of 2,498.5 steps. The SEE of 2,498.50 steps explained the average value each subject varied from the predicted score or predicted line of best fit. Once again, the R-value of .430 indicated that the results did not have a good fit around the predicted line from the regression equation. Age and BMI as predictors did not further predict variance in the regression equation ( $Y = 13,914 + 1,963 (\text{Gender}) - 1,461 (\text{AVETV})$ ). The explained variances for both results were low with limited explanation from the predictors. A summary of the regression analysis is found in Table 2.

Table 2

Stepwise Regression: Average Step Counts versus Gender, Age, BMI, and Average TV

Model	R	R Square	R Square Change	Significance
Gender	.355	.126	.126	.001
AVETV	.430	.185	.059	.001

\* Response is Average Step Count on 4 predictors, with  $N = 153$

Correlation for BMI and average step count showed a low, negative correlation of -.140 for female participants. For male participants, a moderate, negative correlation of -.544, which was significant at the 0.01 level. When step count and TV were correlated,



females had a low, negative correlation of  $-.225$ , and males showed correlation of  $-.531$ , which was significant at the  $0.01$  level.

## **Chapter Five**

### **Discussion**

The results from the present study imply that the three variables in question did not show a strong relationship. Males were more active than females in regard to mean step count. Correlation for step counts and BMI had a low, negative relationship for all participants. Average step count and average TV viewing also showed a low, negative relationship. Gender was an important predictor in terms of predicting step count with a common variance of 12.6%.

The aim of this study was to examine the relationships and predict physical activity using the variables BMI, step count, and television viewing among 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> grade students. Pedometers can be used by researchers when conducting studies that evaluate activity levels of young people, and can offer physical educators and parents an easy to understand method for assessing activity levels of their children. In line with the literature (Rowlands, Eston, & Ingledew, 1999), boys in the present study accumulated more steps than girls. A possible explanation is that boys' sports and play activities are often more vigorous than girls' activities (Hovell, Sallis, Kolody, & McKenzie, 1999). Another explanation is that, although the pedometer used in the present study is unable to measure intensity levels, engagement in physical activity of higher intensity might result in higher step counts even though the number of minutes of engagement would remain the same.

The higher counts in boys compared with girls shows that the feasibility for reaching general standards based on step counts might differ between genders and may

indicate that, even at a young age, physical activity promotion for girls might need special attention. However, the need for the formulation of gender-specific standards is debatable. On the other hand, claiming that girls do not have to be as active as boys could send the wrong signal to children, parents, and physical educators. Table 1 gives some insight into this question but not a clear answer. For all girls in the present study, the mean step count was 10,316.7 steps. Therefore, a reasonable standard for average daily step count might be in the range of 11,000 steps per day. For all boys in the present study, the mean step count was 12,283.2 steps, which would seem to make 13,000 steps a reasonable standard for average daily step count. The release of the Presidential Active Lifestyle Award (2001) set a standard of 11,000 steps for both boys and girls. This single standard for both sexes was done for ease of administration and because it was difficult to identify a physiological construct for differing standards. However, since growing evidence consistently shows that males accumulate more steps than females, having a single set standard for both genders may not be practical. It was argued that setting lower standards (e.g. 11,000 girls and 13,000 boys) could undermine attempts to address the obesity epidemic, and send a harmful message to girls that they don't have to be as active as boys.

The step count data for males and females in this study relates to what the research claims. In the present study, boys had a higher mean step count when compared to girls. Vincent et al. (2003) concluded similar results. American males ages 6-12 had a mean step count of 12,554 to 13,872 steps, and females totaled 10,661 to 11,383 steps. Barfield, Rowe, and Michael (2004) found similar conclusions when comparing step

counts of children during school day activities. With step counts accumulated during classroom, recess, and Physical Education times, boys displayed significantly higher mean step counts than females ( $4,464 \pm 1,427$  and  $3,796 \pm 1,248$ , respectively). The findings of this study were similar to the present study in that males tend to be more active than females in terms of step counts. Another possible explanation to account for the difference may be the types of activities children do at recess. Boys tend to be involved in more tag-like games and sport oriented games, such as football or basketball. Girls at recess tend to steer away from these types of activities, and focus their concerns on jumping rope or playing catch. A significant mean difference between genders existed only during recess ( $t = 3.02$ ,  $p < .05$ ,  $d = .74$ ) (Barfield et al., 2004).

In the present study, when examining the correlation of BMI and average television viewing time for all subjects, a moderate, positive correlation of .484 was calculated with significance at the 0.01 level. It was concluded that as TV viewing increased, BMI scores tended to increase. Although the correlation was significant, the relationship between the two variables was not as high as expected. The present study didn't measure computer or video game time; only TV viewing time. Average viewing time for both genders was 2.46 hours/day. Similar results were found by Crooks (2000) who showed no correlation between obesity and television watching among Appalachian school children. The same number of hours was spent watching TV for both obese and non-obese viewers with no significant difference in the number of hours between the two groups. Lindquist, Reynolds, and Goran (1999) reported that children who watched more TV were not less physically fit. McMurray et al. (2000) determined that African

American status and low socioeconomic status overshadowed any direct effect of TV or video usage. Although TV watching is a sedentary activity, it has not been overwhelmingly supported in the literature as a cause of obesity. It is recommended that future studies include other variables to gain a better understanding of the relationship between media viewing and obesity. The data from this study showed a positive, moderate correlation between BMI and average TV viewing for both genders. The correlation of .484 was significant at the 0.01 level. From this study, it was concluded that as a participant's TV viewing increased, their BMI score tended to increase as well.

The low-moderate correlations between BMI and average step counts versus average step count and average TV viewing for both male and female subjects showed little relationship. The correlations for the two were very low and not significant for females, but were moderate and significant for males. This may be due in part to the fact that the study was conducted with a small, homogeneous sample size ( $n = 153$ ), and the subjects were not randomly selected. In the present study, the correlation for BMI and average step counts in females was a negative, low correlation of  $-.140$ . The data in this study concluded that as female subject's BMI increased, their average step counts decreased. Males in the study had varying results. The relationship for males in terms of BMI and average step counts showed a negative, moderate correlation of  $-.544$  which was significant at the 0.01 level. From the data in this study it was concluded that as a male subject's BMI increased, their average step counts tended to decrease. The results from the present study are similar to the results found by Vincent et al., 2003). This study was conducted on 6-12 year old subjects, and correlation analysis found little relationship

between BMI and step counts. Significant correlations at  $P < .01$  were found for American boys ages 11 ( $r = -0.389$ ) and 12 ( $r = -0.553$ ) and American girls age 9 ( $r = -0.364$ ). American girls age 8 ( $r = -0.276$ ) had significant correlations at  $P < .05$ . The relationships found were in the direction expected (negative), and the greatest correlation ( $r = -0.553$ ) for 12 year old American boys accounted for 28.4% of the variance.

BMI scores for males and females in this study had surprisingly similar results. Males in the study had a mean BMI of 20.35 with SD of 4.27, and females had a mean BMI of 20.24 with SD of 4.97. The reason for similar mean scores can't be explained in the present study. As unique as the results appear, it was important to note the striking similarity between the two means and standard deviations.

In the present study, females showed a negative, low correlation between average step counts and average TV viewing. A relationship of  $-.225$  indicated that as a female subject's average step count decreased, their average TV viewing time tended to increase. Males in the study had a correlation of  $-.531$  which was significant at the 0.01 level. The negative, moderate correlation from the data in this study indicates that as a male subject's average step count decreased, their average TV viewing time increased. The correlation between these two variables showed a significant, negative relationship in a study by Robinson et al. (1993). In this study, 971 sixth and seventh grade girls were evaluated to see if there was a relationship between television viewing time and activity levels. Reported hours of television viewing were negatively associated with activity levels (Spearman  $r = -.086$ ,  $P = .026$ ), with the association accounting for less than 1% of the variance. Although much of the research does not support a strong relationship

between TV viewing and youth obesity, the findings from this study should not be misinterpreted as a defense of TV viewing.

### *Conclusions*

All conclusions are based on the results of this study with 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> grade students from three catholic schools in an urban Midwestern city. It is not recommended that the conclusions be generalized beyond the population participating in this study.

Conclusions which can be drawn are:

- There were gender differences in mean total of steps taken by females and males. Boys are more physically active than girls.
- For all subjects, there was a low, negative correlation (-.191) between BMI and average step counts which was significant at the 0.05 level.
- For all subjects, there was a low, negative correlation (-.244) between television viewing time and average step counts which was significant at the 0.01 level.
- For all subjects, there was a moderate, positive correlation (.484) between BMI and average television viewing time which was significant at the 0.01 level.
- For females, there was a low, negative correlation (-.140) between BMI and average step counts which was not significant.
- For males, there was a moderate, negative correlation (-.544) between BMI and average step counts which was significant at the 0.01 level.
- For females, there was a low, negative correlation (-.225) between average step counts and television viewing time which was not significant.

- For males, there was a moderate, negative correlation (-.531) between average step counts and television viewing time which was significant at the 0.01 level.
- Percent of variance explained was greatest with gender as a single predictor.

### *Recommendations for Future Research*

The following recommendations for future research are based on the findings of this study. Based on the results of this study, it is recommended that future research investigates other variables that may contribute to the youth obesity epidemic. Other variables such as computer/video game time, dietary habits, and socioeconomic status could be analyzed to determine if they have any relationship to one another. The findings in the present study were limited to school day activities and should be extended to address weekend activities. Future researchers should also address interinstrument comparisons among pedometers to endorse a particular model as the gold standard (Tudor-Locke & Myers, 2001).

It has been hypothesized by many that the physical activity patterns established in childhood carry over into adulthood patterns of physical activity, yet there is little research which directly supports these claims. These questions may be addressed by longitudinal, or age stratified studies of specific populations through the use of pedometers to collect step data. Related to lifelong patterns of physical activity, is the need for more research on the causes of physical activity attrition, and on intervention strategies for an increasingly sedentary population.

Although limitations are a part of every research study, future research should focus on data collection from a broader range of youth subjects. In this study, data was



collected on 153 students from three catholic schools. Future studies should try to increase the sample size from a wider variety of schools and investigate other grade levels to obtain a better representation of the youth population. The sample size in this study was obtained from a convenience sample of subjects and schools. Future research should try to obtain a random sample of subjects from various demographics if results are to be generalized to other settings.

The use of alternative instrument tools to classify subjects as either obese or non-obese, besides BMI scores, may need consideration. Although BMI scores are only predictors of body fatness, they can be a valuable measure when dealing with a large sample size of subjects. One drawback to BMI is the fact that subjects can be incorrectly under or over estimated for obesity, and provided with inaccurate information about their body fatness levels. BMI should always be reported in relation to age. It may be preferred to use skinfold assessments or underwater weighing measures if time and costs are practical.

A final limitation that warrants discussion is the testing period in the present study. Subjects in this study were evaluated during four school days. Future studies may incorporate weekend activity times to obtain a more representative data set of subject's activity times.

In summary, research on the physical activity patterns of children and the use of pedometers to evaluate activity levels is in its infancy. Although there are many articles in the literature on this topic, the fact is there is much to be learned about how activity patterns can be assessed through the use of pedometers for all ages and populations.

With the recent information that physical inactivity is considered to be a contributing factor to heart disease, diabetes, and other types of diseases, it is imperative that we continue to investigate any and all relationships, causes, activity assessment tools, and determinants of physical activity patterns for all people.

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**APPENDIX A**

PARENTAL CONSENT FORM

&

INSTITUTIONAL REVIEW BOARD FORM

### **Consent To Be a Research Participant**

**Project Title: THE RELATIONSHIPS AMONG BODY MASS INDEX, DAILY STEP COUNT, AND TELEVISION VIEWING TIME IN CHILDREN AGES 10 TO 13.**

Dear Parent/Guardian:

My name is Scott Ronspies, and I am a graduate student at the University of Nebraska at Omaha. I am conducting a research project under the direction of Dr. Michael Messerole to determine the relationships among body mass index, daily step count, and television viewing time in children ages 10 to 13. You and your child are invited to take part in this research study. The information in this form is meant to help you decide whether or not to take part. If you have questions at any time, please feel free to ask. You are being asked to participate in this research study because your child is a student between the grades of 5<sup>th</sup>-7<sup>th</sup> grade at this school.

The prevalence of youth obesity is increasing at an alarming rate. There is growing agreement among professionals that environment plays a crucial role in the youth obesity epidemic. The lifestyles and diets of American children are changing in response to our technological culture and the availability of a wide range of foods. Access to computer games, video games, and various television programs may also be contributors to the growing problem of youth obesity. The purpose of this research study is to examine the relationships between body mass index, daily step counts, and television viewing time among students in 5<sup>th</sup>-7<sup>th</sup> grade at this school. The relationship of these three variables will be examined to see if they may be contributing factors to youth obesity.

Your child's participation will involve having their height and weight recorded by myself in confidentiality in a private area of school. They will also be asked to fill out a survey, with your help, as to the amount of TV they watch daily. Your child will also wear a pedometer for 4 consecutive school days. A pedometer is a simple device which is placed on the waist band of your child's pants or clothing to record the total number of steps they take while wearing it. Your child's participation in this study is voluntary. The alternative to being in this research study is that you can choose not to participate. If you choose not to participate or to withdraw from the study at any time, there will be no penalty, and your child's grade or standing at school will not be altered. There will be no cost to you to be in this research study and you will not be paid to be in this research study.

The study will be conducted during the months of September/October. On the days your child participates, they will be given a pedometer at school and asked to wear it all day until they go to bed. Please remind them to take the pedometer off if they are going to take a shower or bath, and to set it on a nightstand when they go to bed. On the next

morning, please remind them to put the pedometer back on when they get dressed and have them wear it to school until I collect it. The pedometer is sealed to ensure proper data collection, and your child has been advised not to open it. I recognize that children are not as responsible as adults, so I encourage you to help your child remember to wear the pedometer properly and return it each day they are wearing it. There are no known risks to you or your child from being involved in this research study. All pedometers will be returned to Scott Ronspies upon completion of your child's testing period.

The possible benefit of your child's participation is a better understanding of their physical activity levels. Your child will benefit from wearing the pedometer by becoming more aware of their physical activity level. However, your child may not get any benefit from being in this research study. The possible benefits to society from the information in this study is a better understanding as to what variables may contribute to youth obesity, and how professionals can use a simple device, like a pedometer, to get youth excited about being physically active.

You and your child's welfare is a major concern of every member of the research team. If you have a problem as a direct result of being in this study, you should immediately contact one of the people listed at the end of this consent form. Reasonable steps will be taken to protect your child's privacy and the confidentiality of their study data. Each child will be given a code number to protect their name from being linked to the data collected on them. All data will be analyzed by the Principal and Secondary Investigators, and data will be stored in a locked drawer when not in use. The only persons who will have access to your research records are the study personnel, the Institutional Review Board (IRB), and any other person or agency required by law. The results from this study may be published in a journal and/or presented at a professional conference. Your child's name or identity will not be revealed. In order to keep this confidentiality, a code number will identify your child in this study. Documents that link your child's name with this code number will be kept separate and secured from the completed data forms.

You have rights as a research subject. These rights have been explained in this consent form and in *The Rights of Research Subjects* that you have been given. If you have any questions concerning your rights, talk to the investigator or call the institutional Review Board (IRB), telephone (402) 559-6463. Once again, you can decide not to be in this research study, or you can stop being in this research study ("withdraw") at any time before, during, or after the research begins. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator, or with the University of Nebraska at Omaha. You will not lose any benefits to which you are entitled. If the research team gets any new information during this research study that may affect whether you would want to continue being in the study you will be informed promptly.

If, having read the information on this form, you decide to consent to your child's involvement in this study, please sign and return this consent form to Scott Ronspies. Your child will also be given the opportunity to agree to be a participant in the study. I truly appreciate your interest in this study.

You are freely making a decision whether to be in this research study. Signing this form means that (1) you have read and understood this consent form, (2) you have had the consent form explained to you, (3) you have had your questions answered and (4) you have decided to be in the research study. If you have any questions during the study, you should talk to one of the investigators listed below. You will be given a copy of this consent form to keep.

Signature of Parent/Guardian:\_\_\_\_\_ Date:\_\_\_\_\_

Time:\_\_\_\_\_

Printed Name of Student:\_\_\_\_\_ Date:\_\_\_\_\_

Time:\_\_\_\_\_

My signature certifies that all the elements of informed consent described on this consent form have been explained fully to the subject. In my judgment, the participant possesses the legal capacity to give informed consent to participate in this research and is voluntarily and knowingly giving informed consent to participate.

Signature of investigator:\_\_\_\_\_ Date:\_\_\_\_\_

Time:\_\_\_\_\_

Principal Investigator  
Scott Ronspies  
(402) 968-0618

Secondary Investigator  
Michael Messerole, PhD  
(402) 554-2670



**APPLICATION FOR EXPEDITED IRB REVIEW****PART A**

May 1<sup>st</sup>, 2005

Project Title:           The Relationships Among Body Mass Index, Daily Step Count,  
and Television Viewing Time in Children Ages 10 to 13

Principal Investigator

Scott Ronspies  
HPER Department  
(402) 968-0618

Research Investigator

Michael Messerole, PhD  
HPER Department  
(402) 554-2670

---

Signature of Principal Investigator

Date

---

Signature of Research Advisor

Date

**PART B – Research Question**

The study is designed to determine the relationships between body mass index, daily step count, and television viewing time in children ages 10 to 13. Pedometers are gaining acceptance in Physical Education classes as a valid and reliable means to assess physical activity levels in students. The importance of regular physical activity is now widely accepted. This study will contribute to the assessment of physical activity through pedometers, and how variables such as Body Mass Index, step count, and TV viewing time are related in terms of youth obesity. This study will contribute to our understanding of children's physical activity level and aid in the development of intervention programs to help children establish healthy lifestyles and reduce the number of obese children/adolescents.

## **PART C – Hypothesis**

A significant relationship will be found between BMI and step count, BMI and TV viewing time, and TV viewing time and step count for 5<sup>th</sup>-7<sup>th</sup> grade students.

## **PART D – Method**

### **1. Subjects**

- a) Subjects will be volunteers from 5<sup>th</sup>-7<sup>th</sup> grade classrooms in two Midwestern inner-city Private schools in Omaha, Nebraska. A total of 87 male and 66 female subjects will participate in the study.
- b) The study will be described to students during Physical Education classes. A letter describing the study will be sent to parents of all 5<sup>th</sup>-7<sup>th</sup> grade students. Students volunteering will be selected to be a part of the study.
- c) Student code numbers will be used with the data collected to protect confidentiality.
- d) A copy of the parental consent form is included.
- e) The principal investigator is Scott Ronspies. The regular safety protocol for Physical Education classes will be followed therefore special arrangements will not be necessary to protect the subjects.
- f) Information regarding subject data will be made available to each individual student and their parents upon request.

### **2. Procedure**

- a) Students who volunteer from the three Private schools will participate in the study.
- b) Your child's participation will involve having their height and weight recorded by myself in confidentiality in a private area of school. They will also be asked to fill out a survey, with your help, as to the amount of TV they watch daily. Your child will also wear a pedometer for 4 consecutive school days. A pedometer is a simple device which is placed on the waist band of your child's pants or clothing to record the total number of steps they take while wearing it. Your child's

participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty, and your child's grade or standing at school will not be altered.

The study will be conducted during the months of September/October. On the days your child participates, they will be given a pedometer at school and asked to wear it all day until they go to bed. Please remind them to take the pedometer off if they are going to take a shower or bath, and to set it on a nightstand when they go to bed. On the next morning, please remind them to put the pedometer back on when they get dressed and have them wear it to school until I collect it. The pedometer is sealed to ensure proper data collection, and your child has been advised not to open it. I recognize that children are not as responsible as adults, so I encourage you to help your child remember to wear the pedometer properly and return it each day they are wearing it.

- c) The above procedures will be followed on all subjects who have worn the pedometer each of the four school days.
- d) There will not be any deceptive practices used throughout the study.

### **3. Proposed data analysis**

- a) The investigator will record each subject's height, weight, and daily step counts.
- b) The total number of steps taken will be calculated for each subject. Mean number of steps taken will be calculated by gender. Standard deviations will be identified by gender. Pearson r correlations and stepwise regressions will also be used to analyze the data.

### **PART E – Risk/Benefit Analysis**

Pedometers are gaining wide acceptance in assessing physical activity levels of children in Physical Education classes. Subjects will benefit from participation in this study by gaining a better understanding of their physical activity level, and how this activity can benefit them in their daily lifestyles. It is presumed that youth who are more physically active are healthier and have lower risk factors for heart disease and other risk factors. Prior to the study, subjects were given the opportunity to wear the pedometers in Physical Education classes, and gain an understanding of how they properly function.

The pedometer has currently surfaced as a means of assessing the daily physical activity levels of children. The pedometer used in this study will be the DIGI-WALKER step counter model number SW-200. This pedometer only records number of steps. This pedometer has been used in research involving both adults and children, and has been shown to be one of the most valid and reliable pedometers on the market. The pedometer measures vertical acceleration, recording a step each time the hip moves up and down. The step counter has a suspended arm mechanism inside the counter, which detects steps, plus other movements. The pedometer will be worn on the waistband in line with the subject's right knee. A security strap will also be attached to help protect the counter from falling to the ground or losing it. The pedometer is small, light weight, and will not restrict movement. Subjects have previously used the pedometers during Physical Education classes. There is no physical risk for participants.

The literature dealing with pedometers and youth is still in its infancy. This study will provide information on the average number of steps taken by age, gender, and grade. The pedometer will provide feedback on the amount of physical activity in number of steps taken. The convenience of the pedometer and economical cost makes it a useful tool for programs in which children and parents can work together to establish a healthy lifestyle and help fight youth obesity.

#### **PART F – Grant Information**

Grant funding was not utilized for this research study.

**APPENDIX B**

SUBJECT DATA FORM & CHILD ASSENT FORM

**Subject Data Form**

I have been told that my parent/guardian has given permission for me to take part in a study using pedometers. I am taking part because I want to. I know that I can stop at any time and that it will be ok if I do.

Student's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Please answer the following questions:**

\*Child's Age \_\_\_\_\_ in years.

\*Child's Gender (circle one):            Male    Female

\*Grade Level: (circle one): 5<sup>th</sup>    6<sup>th</sup>    7<sup>th</sup>

\*Child's Ethnicity:

\_\_\_ African American

\_\_\_ Hispanic

\_\_\_ Native American

\_\_\_ Pacific Island/Asian

\_\_\_ White

\_\_\_ Other: \_\_\_\_\_

## **CHILD ASSENT FORM**

### **CHILD ASSENT FORM**

#### **TITLE OF RESEARCH STUDY**

#### **THE RELATIONSHIPS AMONG BODY MASS INDEX, DAILY STEP COUNT, AND TELEVISION VIEWING TIME IN CHILDREN AGES 10 TO 13**

1. We would like to ask you to be in this study about how your body mass index, daily step counts, and your TV viewing time relate to youth obesity.
2. We would like to talk to your parents about this before you decide whether or not to be in this study. We will also ask your parents whether they want you to be in this study.
3. If you have any questions at any time, please ask.
4. In this study, we will examine the correlations (relationships) between body mass index, daily step count, and TV viewing time in children ages 10 to 13.
5. In this study, you will have your height and weight calculated to obtain you BMI score, and you will wear a pedometer on your waistline for 4 school days in a row. We will also ask you to write down how many hours of TV you watch on each of these 4 school days as well. All pedometers will be returned to Scott Ronspies upon completion of your testing period.
6. The information we obtain from this study will help us understand if step counts BMI, and TV viewing time have a relationship to youth obesity.
7. You do not have to be in this study. If you decide to be in this study, you are free to stop at any time. Your decision will not change your relationship with the investigators who are in charge of this study.

Student's initials: \_\_\_\_\_

**You are making a decision whether to be in this study. Signing this form means that you have decided to be in this study and have read all that is on this form. You and your parents will be given a copy of this form.**

---

**Signature of Subject**

---

**Date/Time**

---

**Signature of Investigator**

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**Date/Time****Authorized Study Personnel****Principal Investigator**

**Scott Ronspies (402) 968-0618**

**Secondary Investigator**

**Michael Messerole, PhD (402) 554-2670**



**APPENDIX C****INDIVIDUAL SUBJECT DATA SHEET**

	Monday	Tuesday	Wednesday	Thursday	Friday
Steps					
Subject Code #:_____	Age:_____	Gender:_____	Grade:_____	Ht (inches):____ Wt(lbs.):_____	

BMI Score:\_\_\_\_\_

**Appendix D****SELF-ADMINISTERED PHYSICAL ACTIVITY CHECKLIST FORM  
(SAPAC)**

## CHILD AND ADOLESCENT TRIAL FOR CARDIOVASCULAR HEALTH

### SELF-ADMINISTERED PHYSICAL ACTIVITY CHECKLIST (SAPAC)

**AFFIX ID LABEL HERE -->**

\_\_\_\_\_

## SECTION A. GENERAL INFORMATION

**(CATCH STAFF USE ONLY)**

- A1. FORM VERSION: 0 / 2 / 3 0 / 2 3  
M D Y
- A2. TODAY'S DATE: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
M D Y
- A3. ADMINISTRATOR'S INITIALS \_\_\_\_\_
- A4. SCHOOL STARTING TIME: \_\_\_\_\_ : \_\_\_\_\_
- A5. SCHOOL ENDING TIME: \_\_\_\_\_ : \_\_\_\_\_

- A6. DID YOU PARTICIPATE IN PHYSICAL EDUCATION CLASS YESTERDAY?**

NO ..... 1  
YES ..... 2

- A7. IF YES, HOW MANY MINUTES LONG WAS PHYSICAL EDUCATION CLASS?**

## Minutes

- A8. DID YOU PARTICIPATE IN RECESS YESTERDAY?**

**NO.....1**  
**YES.....2**

- A9. IF YES, HOW MANY MINUTES OF RECESS DID YOU HAVE?**

Minutes First Recess         |      |         Minutes Second Recess

## SECTION B. ACTIVITIES

	Activity	Before School	During School	After School
1	Bicycling			
2	Swimming Laps			
3	Gymnastics: bars, beam, tumbling trampoline			
4	Exercise: push-ups, sit-ups, jumping rope			
5	Weight lifting			
6	Basketball			
7	Baseball/Softball			
8	Football			
9	Soccer			
10	Volleyball			
11	Skating: ice, roller, roller blade			
12	Hockey: ice, floor, field			
13	Racket Sports: badminton, tennis, paddleball			
14	Ball Playing: four square, dodge ball, kickball			
15	Active Games: chase, tag, hopscotch			
16	Outdoor Play: climbing trees, hide and seek			
17	Water Play: (in pool, ocean or lake)			
18	Combatives: judo, karate, competitive wrestling			
19	Dance			
20	Outdoor Chores: mowing, raking, gardening			
21	Indoor Chores: mopping, vacuuming, sweeping			
22	Skateboarding/Scooter (non-motorized):			
<i>* We walk and/or run many times throughout the day, often for less than 5 minutes at a time. A good example of this is going from class to lunch. Sometimes we do a combination of walking and running, where we walk some and run some. We call this mixed walking and running. *</i>				
23	Mixed Walking/Running			
24	Walking			
25	Running			
26	Other, Name of Activity:			
27	Other, Name of Activity:			

Now I want you to think about any TV, videos, or DVD you watched, or video or computer games you played...

	BEFORE SCHOOL		AFTER SCHOOL	
T.V./Video/DVD	hours plus	minutes	hours plus	minutes
Video Games & Computer Games	hours plus	minutes	hours plus	minutes